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Power Plant Testing

Up

PTI is an independent test contractor with extensive power plant performance and test and expertise. PTI has performed tests for plant developers, component manufacturers and owners. Unbiased and thorough testing is important because performance penalty/bonus typically several million dollars! Test results can vary widely, depending on the contract procedures, the instrumentation, the calibration plan, and the interpretation of the result corrections to contract conditions.

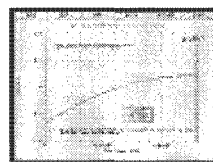
PTI is proud that in some instances of conducting acceptance tests, we have been able to make recommendations that save the owner more than the cost of the test program! For example, an opening in a gas turbine enclosure was allowing heat to enter the air inlets. In heat recovery steam generator bypass valve was discovered to be installed backwards, a bank of superheater tubes.

PTI assembles the test instrumentation to meet or exceed the code and contract requirements. PTI can provide the instrumentation, from precision manual equipment to complete data acquisitions systems. In either case, preliminary test results are provided immediately after the run.

PTI performs an uncertainty analysis to determine the effect of each instrument on the test results. This allows the owner to understand which measurements are critical. This could result in the use of a flow straightener, a flowmeter, an additional thermowell, or other redundant test point.

To improve test accuracy, PTI computes the fuel heating value from the fuel component analysis. PTI calculates flow from the raw measurements. Also, PTI compensates power measurements for the effects of burden on the potential transformers. Although the effects on the test results are small, attention to detail can have a six figure influence on bonus/penalty payments.

To avoid disputes over the eyeballing of correction curves, all curves are converted into a standard form. All parties agree to prior to testing. (See Figure 1) Curvefit equations provide improved simple linear interpolation. The curvefits also facilitate computer-generated results as the test is ongoing.

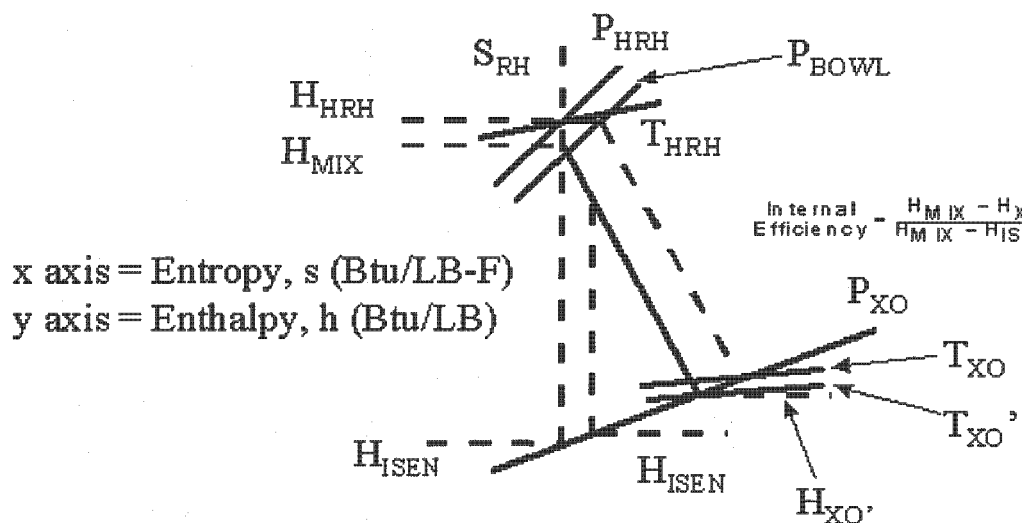


PTI also offers test witnessing services, or test review services. PTI has been involved in cases where penalties or bonuses have been claimed, only to be completely reversed under PTI's services. PTI is uniquely qualified to define an unbiased test that considers hundreds of test influencing factors that is fair to all parties.

Our staff and associates are well versed in the ASME and International performance test codes. Westcott is a member of the ASME Performance Test Code (PTC) Board, Dave Ahner is a member of the Overall Plant PTC-46 committee.

Our staff are power plant engineers first, test engineers second. Thus, PTI is able to interpret results (See Figure 2 - Effect of Internal Leakage) and diagnose any deficiencies (Figure Turbine T-S Diagram).

The apparent efficiency of an intermediate, opposed flow steam turbine is easily calculated from steam conditions entering and exiting the turbine. However, determining the actual efficiency compensating for the valve pressure drop, the internal packing leakage (N₂), and the location of the exiting steam.

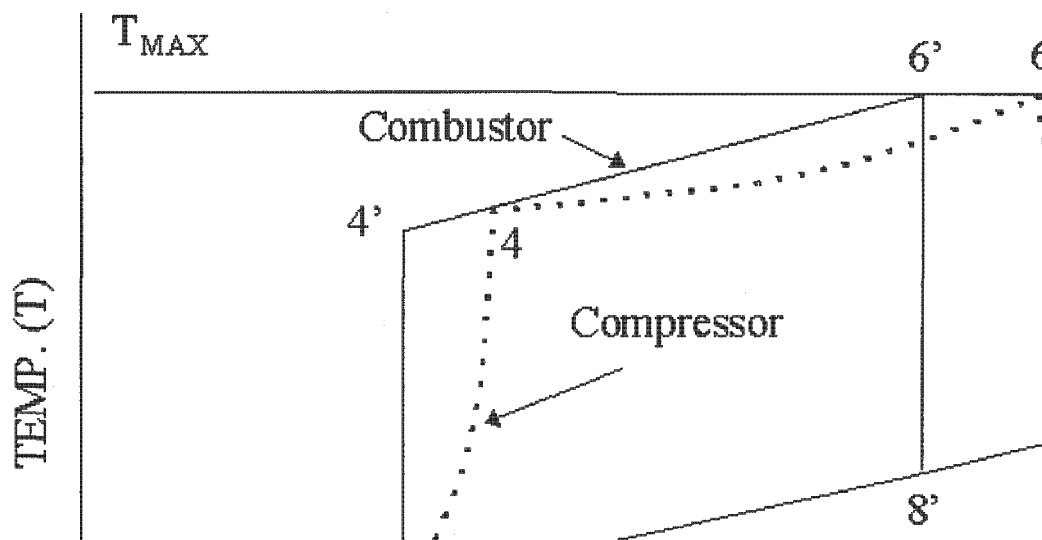


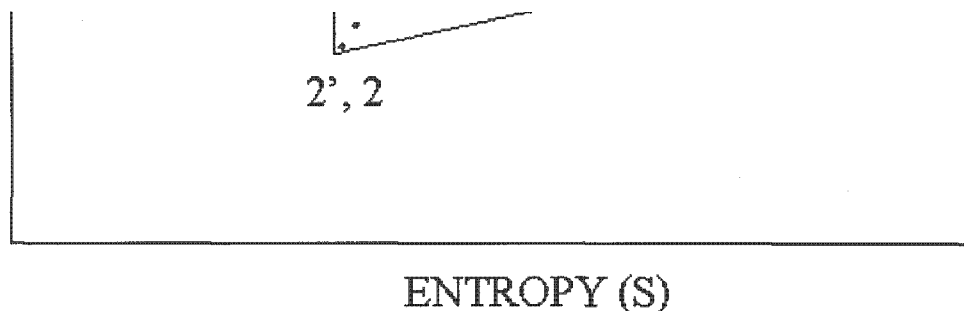
IP Turbine Efficiency

Valve Pressure Drop = 2%

Internal Leakage (N₂) = 1.5%

Figure 2. Effect of Internal Leakage





Existing test codes are primarily for acceptance testing of individual components. There performance test codes for testing entire steam plants or combined cycle plants. Howe work in progress to develop a test code for overall plants, and PTI is on the forefront in 93-JPGC-PTC-1&2). This makes PTI uniquely qualified to prepare system wide test pla acceptable and binding to all parties.

PTI annually teaches 60 power technology courses to up to 1500 students, worldwide. combined cycle technology, power plant performance, and others.

PTI teaches a 3-day course on power plant testing. By attending this course, our clients conversant in the ways that the test outcome can be influenced by test definitions, proc instrumentation, calculation methods and by the applications of correction factors. Topi include:

- ◆ Instrumentation and Calibration
- ◆ Test Planning
- ◆ Corrections to Standard Conditions
- ◆ Combined Cycle Performance Testing
- ◆ Gas Turbine Performance Testing
- ◆ Heat Recovery Steam Generator (HRSG) Testing
- ◆ Steam Turbine Performance Testing
- ◆ Condenser Performance Testing
- ◆ Cooling Tower Performance Testing
- ◆ Statistical Treatment of Experimental (Test) Data
- ◆ Fuel Sampling and Analysis

CASE HISTORIES:

- ◆ PTI served as the owner's engineer to oversee performance acceptance tests of turbine plant with circulating bed boilers, as performed by the architect engineer. a substantial (7 figure) gain for the owner.
- ◆ PTI served as the owner's engineer to oversee performance acceptance tests of turbine plant with circulating bed boilers that was to be performed by the architec modified the test procedures to improve accuracy of the test. The plant met perf
- ◆ PTI performed an Engineering review of net station heat rate performance test re cogeneration plant. The plant was an 80 MW coal fired steam turbine plant with extraction to process. Resulted in substantial (6 figure) gains for the owners.
- ◆ PTI conducted turbine acceptance testing on an 80 MW simple cycle gas turbine NO_x tuning, capability, performance, noise and emission testing. The turbine met guarantees (1992).
- ◆ PTI provided consulting services for turbine acceptance testing conducted by the manufacturer on four 80 MW simple cycle gas turbines (1992).
- ◆ PTI provided consulting services for turbine acceptance testing conducted by the manufacturer on an 80 MW simple cycle gas turbine. The unit did not meet perfo guarantees due to quotation oversight overlooking the sound attenuation backpr
- ◆ PTI conducted a performance test for a 2-stage absorption chiller, which resulte figures) to the owner (1995).
- ◆ PTI conducted or supervised a complete set of acceptance tests for a combined including overall plant test to satisfy investment bankers, the overall cogen plant

overall guarantees, and the individual component tests (GT, HRSG, ST, condensers, heat exchangers, absorption chillers) (1995).

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